Energy, power and resistance	Resistance
Learning objectives	MUST (6) Be able to explain resistance of a component
	SHOULD (7) Recall, rearrange and apply Ohm's Law
	COULD (8/9) Interpret simple I-V graphs

STARTER: Green pens out - prepare to self-mark your homework!

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Energy, power and resistance | Resistance

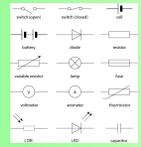
MUST (6) Be able to explain resistance of a component

What does resistance measure, and what is it measured in?

Components have an associated resistance, which is a measure of opposition to a flow of charge. It is measured in ohms (Ω).

Definition of an ohm: if a potential difference of 1V applied across a component produces a current of 1A, the resistance of that component is 1Ω.

Do components have a single associated resistance? Does it change? If so, why and how? Can you think of components that are specifically designed to have differential resistances?



Why does resistance normally increase with temperature?

Metal ions vibrate more, so electrons collide more.

So how can some thermistors have resistance decreasing with increasing temperature?

They are semiconductors, and temperature releases more charge carriers

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Energy, power and resistance | Resistance

SHOULD (7) Select and apply equations for calculations involving resistance

Can you measure resistance directly?

No - you must derive it, by passing a known pd across a component and measuring the current, then using the equation:

$V = IR$ rearranged to $R = \frac{V}{I}$

3 Define the ohm, and express it in base units. (2 marks)

4 A length of wire is connected to a cell. The current in the wire is 80 mA and the p.d. across the wire is 2.4 V. Calculate the resistance of the wire. (3 marks)

5 A resistor has a resistance of 1.2 kΩ. In 3.0 minutes a charge of 54 C flows through the resistor. Calculate the p.d. across the resistor. (2 marks)

6 The current in a filament lamp is 1.5 A. It is operated for a time of 1.0 minutes. The charges flowing through the lamp transfer 500 J of energy to the lamp. Calculate the resistance of the lamp. (3 marks)

4 One ohm is the resistance of a component when a p.d. of 1 V is produced per ampere of current. [1]
(See 9.2 question 3 to get the base units of the volt.)
$R = \frac{V}{I}$
R [Ω], V [kg m² s⁻³ A⁻¹], I [A] [1]
[Ω] = [kg m² s⁻³ A⁻¹] × [A⁻¹]
Which becomes:
[Ω] = [kg m² s⁻³ A⁻²]
Therefore, in base units the ohm is equal to kg m² s⁻³ A⁻² [1]

5 $I = \frac{Q}{t} = \frac{54}{180} = 0.30$ A [1]
$R = \frac{V}{I}$ therefore $V = IR = 0.30 \times 1200 = 360$ V [1]

6 $I = \frac{Q}{t}$ and $V = \frac{W}{Q}$ therefore $V = \frac{W}{I\ t}$ [1]
$V = \frac{500}{1.5 \times 60} = 5.55...$ V [1]
$R = \frac{V}{I} = \frac{5.55...}{1.5} = 3.7\ \Omega$ (2 s.f.) [1]

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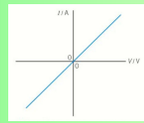
Energy, power and resistance | Resistance

COULD (8/9) Interpret simple I-V graphs

I-V graphs: current on y-axis and pd on x-axis.

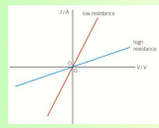


a) What does the gradient relate to?

b) What could this be an I-V graph representing?

Important: if the I-V graph is a straight line, the component obeys Ohm's Law and is behaving ohmically.

Which is a high resistance resistor?
Which is low resistance?



Extension: can you sketch a I-V graph for a diode?

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PLENARY: What is the shape of an I-V graph for a lamp? Why?

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